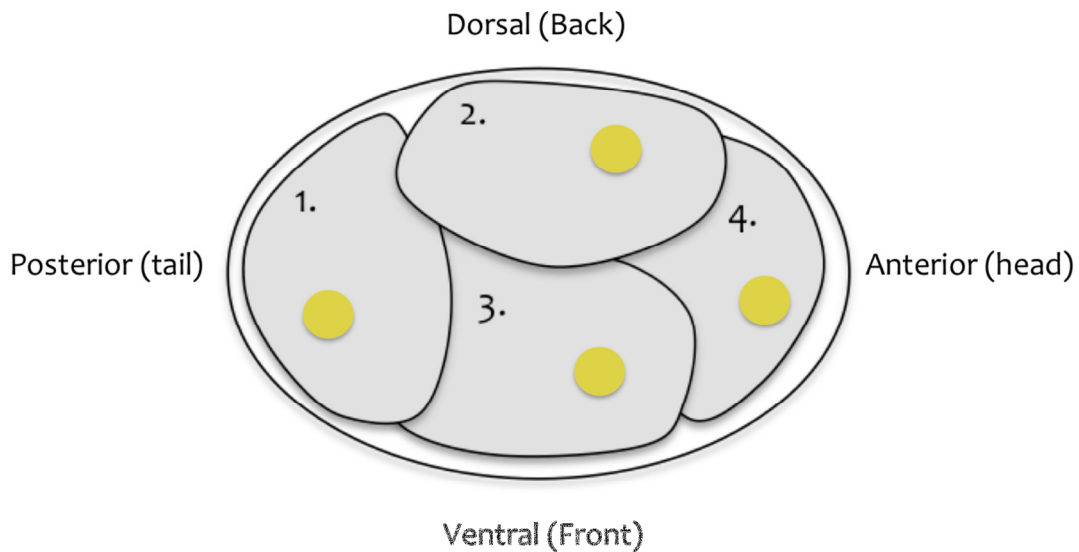


Name _____

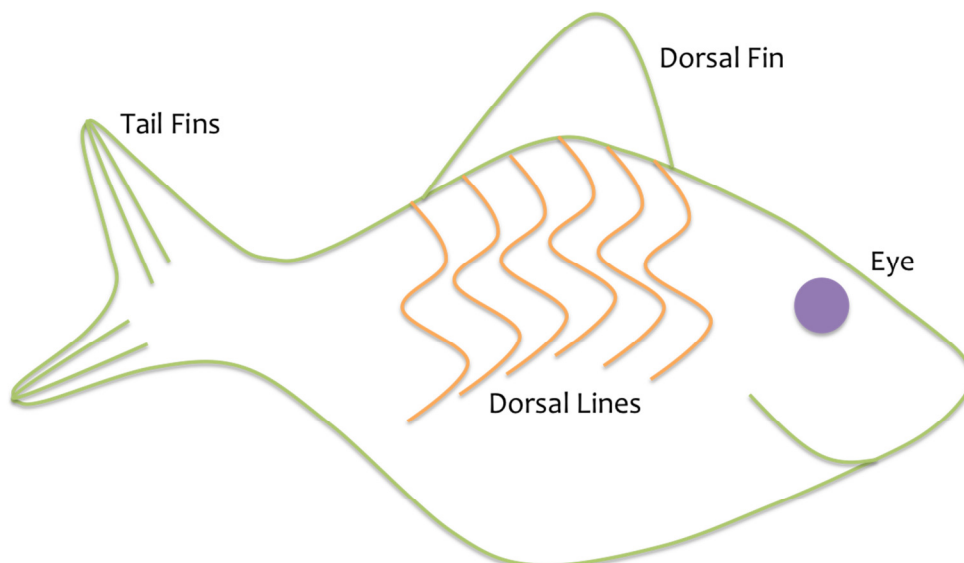
Developmental Gene Regulation

You are a developmental biologist working on a new model system: The Cartoon Fish. Depicted below is a 4-cell stage embryo and the resulting adult organism. The Adult Cartoon Fish has several features including an eye, a dorsal fin, tail fins, and dorsal lines. Note that at the 4-cell stage, the body axes have already been defined.

4-cell stage embryo



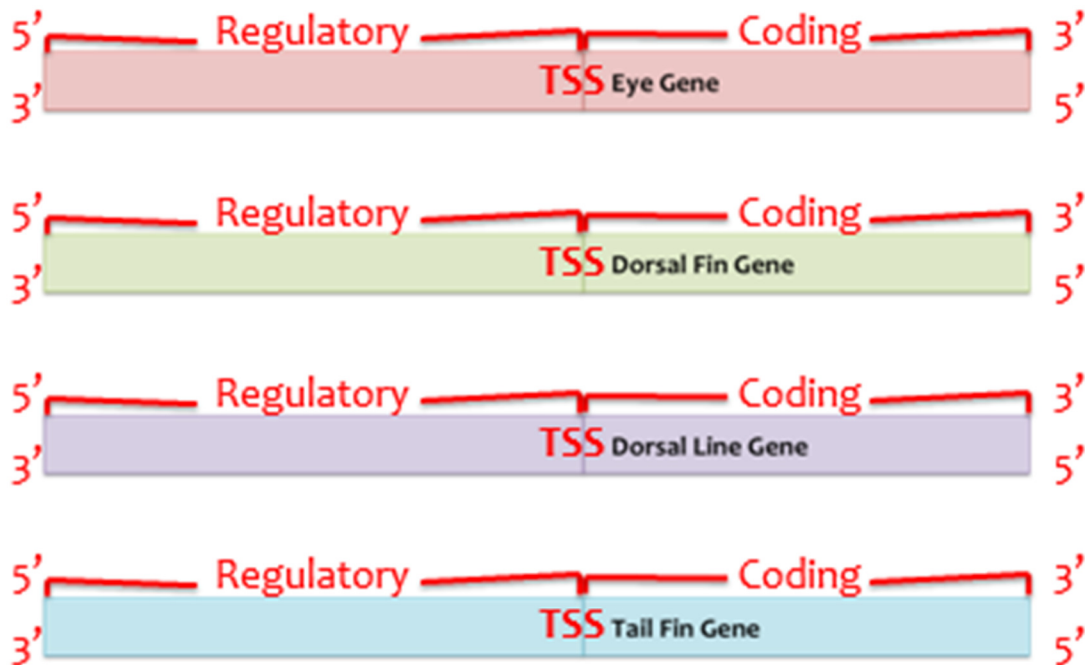
Adult organism



Name _____

If we look closer at the genome of the Cartoon Fish, we see it contains four developmental genes: the Eye gene, the Dorsal Fin gene, the Dorsal Line gene, and the Tail Fin gene.

(Note the transcription start site and the regulatory vs coding regions of each gene.)



There are 5 Transcription Factors that regulate these four genes. Their known functions are described below.



TF_A. Activates the Tail Fin Gene



TF_B. Activates the Eye Gene



TF_C. Represses the Dorsal Line Gene



TF_D. Activates the Dorsal Fin Gene



TF_E. Represses the Dorsal Fin Gene

Name _____

On the diagram below, Draw the Transcription Factor Binding sites.

Tip: Draw the binding sites as shapes that the transcription factors could 'lock into'

Eye Gene

Dorsal Fin Gene

Dorsal Line Gene

Tail Fin Gene

Name _____

Using the diagram below, create a model for how each gene is regulated in each cell during normal development. Draw an X through a gene if it is OFF, draw an arrow if it is ON.

Cell 1:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 2:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 3:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 4:

	Eye Gene
--	----------

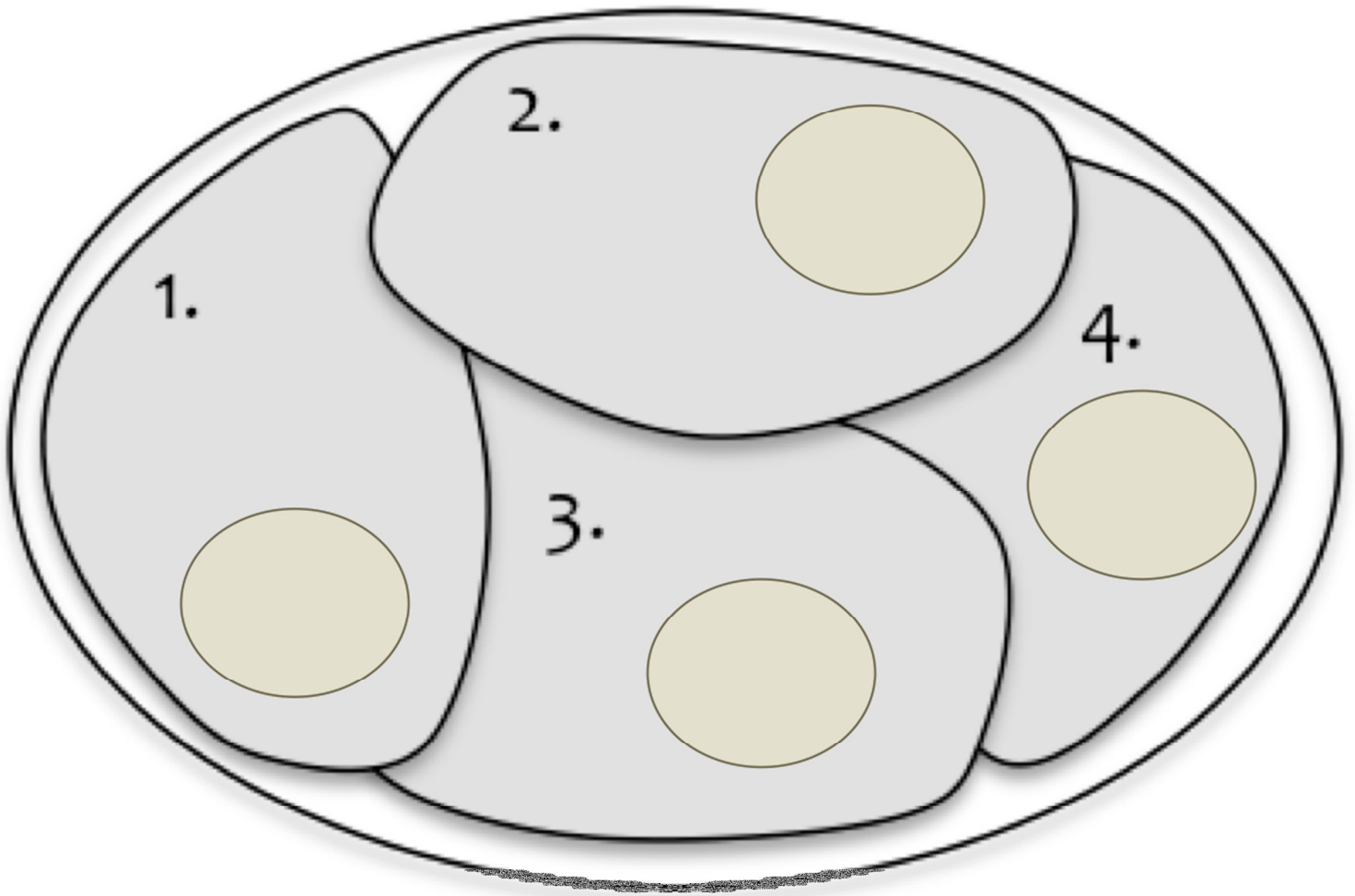
	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Name _____

Draw which Transcription Factors must be present in each cell for normal development. Be sure to draw them in the part of the cell that you would expect them to function!



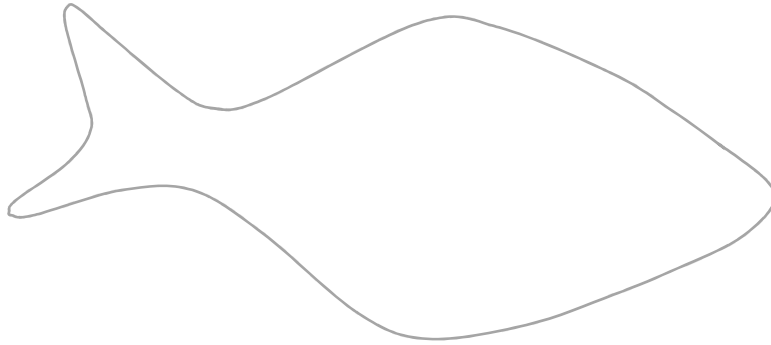
Name _____

Part 2: Effects of Mutation.

You have discovered a mutant that contains a **mutation in the binding site for TF_B**.

This mutation prevents TF_B from binding and activating the Eye gene.

Using the diagram below, draw the phenotype of the adult fish that you would expect from this mutation.



Using the diagram below, draw the effects of this mutation on gene regulation.

Cell 1:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 2:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 3:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 4:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

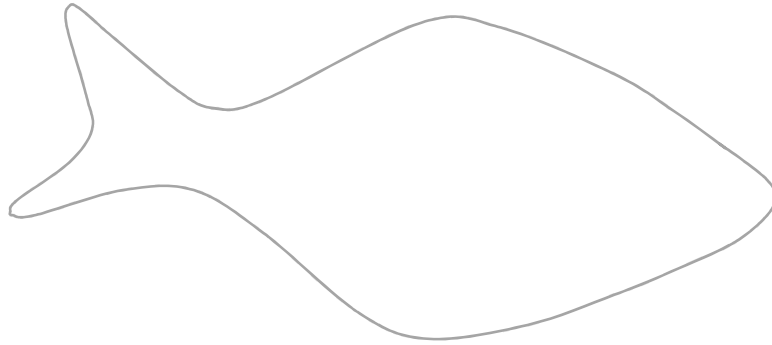
	Tail Fin Gene
--	---------------

Name _____

Part 2: Effects of Mutation.

You have discovered a mutant that contains a **mutation in the binding site for TF_C**. **This mutation prevents TF_C from binding and repressing the Dorsal Line gene.**

Using the diagram below, draw the phenotype of the adult fish that you would expect from this mutation.



Using the diagram below, draw the effects of this mutation on gene regulation.

Cell 1:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 2:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 3:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------

Cell 4:

	Eye Gene
--	----------

	Dorsal Fin Gene
--	-----------------

	Dorsal Line Gene
--	------------------

	Tail Fin Gene
--	---------------